Requisition Date	Delivery Date Desired	F. O. B.	BID OPENING DATE	Requisition No.
April 26, 2010	ASAP		May 19, 2010	

VENDOR NAME AND ADDRESS	Deliver to	Company Name
	LTC Alexandria Campus 4311 South MacArthur Drive Alexandria, LA 71302	
Bidder's Signature _____ Telephone Number: _____ Fax Number: _ ___	Invoice To LTC Alexandria Campus P. O. Box 5698 Alexandria, LA 71307-5698	Bidder's Terms: Delivery Date: **JULY 23, 2010**

DESCRIPTION	QTY	UNIT	ITEM	UNIT PR	AMOUNT
AC/DC Electrical Learning Systems Trainer w/ software **(SEE ATTACHED SPECS)**	2	Each	1		
Electric Relay Control Learning System **(SEE ATTACHED SPECS)**	2	Each	2		
Computer Technology Trainer **((SEE ATTACHED SPECS)**	2	Each	3		
Electric Motor Controls Systems Trainer w/ software & pony brake, fault troubleshooting system, & motor braking system **(SEE ATTACHED SPECS)**	1	Each	4		
Process Control Learning System Trainer- includes PID controller module **(SEE ATTACHED SPECS)**	1	Each	5		
Pneumatic Troubleshooting Learning System Trainer w/software **(SEE ATTACHED SPECS)**	1	Each	6		
Robotics and Computer Programming Trainer w/software **(SEE ATTACHED SPECS)**	1	Each	7		
Flexible Manufacturing Learning System **(SEE ATTACHED SPECS)**	1	Each	8		
		Each	9		
		Each	10		
		Each	11		
Shipping & Handling included in bid quotes delivery to LTC Alexandria Campus Bid. Quotes shall be returned on form provided (with signature) in sealed envelope (identified as sealed bid on outside of envelope)					

Telephone Number Buyer	Louisiana State Sales Tax not to be included in above price or added to the invoice in accordance with Act 612 of the 1982 Louisiana Legislative Session. Price assumed firm unless otherwise stated. All general or special conditions, prices and terms contained in the accepted bid, and official rules and regulations for purchasing shall apply to all purchases.	
(318) 487-5659		

ACCT	FUND	DEPT	CLASS CODE	PROJECT GRANT	PROGRAM	Agency Administrative Officer
5925	31	176300	610	IWTP		

Requisitioned by and Telephone No.:	Signature Approved Agency Official	Requisition Date

May 19, 2010
Bid Open Date (2)

ELECTRICITY LEARNING SYSTEM

This unit shall include: one (1) base unit with (1) power supply on/off selector switch, indicator lamp, AC-DC selector switch and indicator lamps, circuit breaker, output terminals for connection to devices, component work surface and instrument console with component storage panel. Voltages available shall be 24 volts and 12 volts, AC and DC, which is controlled by the AC-DC selector switch. These components shall meet the below minimum specifications.

AC/DC Electrical Systems Trainer

One (1) Analog voltmeter shall be built into the instrument console with terminals so that test leads can be connected for making measurements. Range of the scale is from 0-30 volts, AC or DC. The component storage panel shall allow storage and identification of loose components that are included with trainer. The component work surface shall be a flat surface 20"x17" located on top of the worktable and in front of the instrument console where components can be quickly attached and circuits setup. All loose components shall be mounted on mobile plastic panels with all component leads attached to metal spade-lug terminals which have thumbscrew attachment spade-lugs, requiring no tools. The loose component panels shall use a quick connect mounting /release method which permits the component circuits to be set up on the work surface and storage panel. The components shall include:

(1) Digital multi-meter
(1) Knife switch, DPDT
(1) Push button switch, SPST
(1) Selector switch, SPST
(3) Lamp modules, 28V @ .67A
(2) Resistor modules, 25 ohm
(1) Resistor module, 10 ohm
(2) Capacitor modules, 88-106mF
(1) Relay module, DPDT, 24 VDC
(1) Solenoid module, 24 VDC
(1) Buzzer module, 3-20 VDC 3.7kHz
(1) Fan module, 24 VDC/.11A
(1) Circuit breaker module, 1A/277 VAC
(1) Fuse module, 3AFA
(1) Rheostat module, 1A/0-25ohm 25Watt
(1) Step down transformer module, 20VA
(1) Transformer load module 2 separately selectable 220ohm 5Watt loads
(1) Compass module
(1) Neon circuit tester, 90-300V

Lead Set

A patch cord set shall be supplied which includes the following components

(10) Spade-to-spade connections 24-in length
(4) Spade to banana 24-in length

Electrical Control Software

Windows-based software which provides a graphical interactive simulator of electrical circuit designs. The software shall contain a library of electrical components including power supplies, resistors, voltmeters, connectors, motors, lights and switches to enable the user to construct a variety of electrical circuits to teach the concepts of AC/DC electricity. The software shall then permit simulation of the circuits with a 3-D graphical display on screen in real time. It shall be possible to insert faults into the system, change systems parameters, and analyze system performance. Circuit files can be created, saved, and recalled at any time.

Supplemental Disk for Electrical Control Software

A disk shall be provided which contains circuit simulation files for use with the electrical control software and the activities in the curriculum.

Student Curriculum
Shall consist of one (1) set of six Learning Activity Packets and one (1) Teacher's Assessment Guide. The student curriculum shall contain 47 industry tasks in Electrical Systems including: Ohm's Law calculations, basic components/circuit connections; measurement of circuits, voltage and resistance, sizing and connection of transformers, capacitors and inductors applications and design calculations. Laps and hands on trainer must match online e-learning software verbatium.

Teacher's Assessment/ Portfolio Guide
A teacher's assessment guide shall be provided. It shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets and authentic assessment. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught. All tasks listed in the packet shall be listed on personalized student record sheets. The teacher's assessment guide shall include directions for authentic skill assessment.

Amatrol Model No. T7017 or equal

ELECTRIC RELAY CONTROL LEARNING SYSTEM

Shall include: electrical relay control training console, control components, lead set, power supply, student curriculum and teacher's assessment guide.

Electrical Relay Control Training Console

The training system shall have an angled console with all components rigidly mounted on the front panel for ease of inventory tracking. The panel is to be 18 gauge painted steel with the name and part number of each component clearly silk-screened. The console size shall be 24" L x 18" H x 6" W.

Control Components

Each component's terminals shall be wired to plug-in jacks on the front of the panel, which are overlaid with a silk-screened schematic symbol of the component. The pneumatic and electrical components shall be arranged in such a manner to enable automated control circuits to be connected and operated. The components shall include the items listed below.

- (3) DPDT relays
- (1) Timer relay DPDT
- (2) Pushbuttons
- (1) Selector switch, 3-position
- (2) Double-acting cylinders
- (4) Limit switches
- (2) Solenoid operator valves, 4-way
- (2) Indicator lights

Lead Set

A set of (25) stackable electrical connecting leads shall be supplied to enable circuits to be connected.

Power Supply

A 24VDC 2.4AMP power supply shall be integrated into the base of the Electrical Relay Control Trainer, which provides power to all components on the trainer.

Student Curriculum

Shall include one set of 3 Learning Activity Packets containing at least 31 skills in electrical relay control. The topics shall include: logic elements, ladder diagrams, electro-pneumatic solenoid valves, relay operation, relay application, limit switch operation, limit switch applications, time-delay relays, multiple cylinder control, and machine modes of operation.

The student curriculum shall be designed in a skill-based format that focuses on teaching industry-relevant tasks. The objectives shall be accomplished by organizing the learning material into a series of learning activity packets, which are further subdivided into three or more segments per packet. All learning materials needed shall be contained in the packets including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. The specific cognitive skills taught by each text passage shall be identified next to the passage. Each lab activity shall be identified by the industrial task taught. All activities shall be highly detailed with step-by-step instructions to facilitate a self-directed learning environment. A combination of step-by-step enabling activities and creative, problem-solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. The curriculum must be capable of both self-directed and instructor directed study. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

Teacher's Assessment Guide

A teacher's assessment guide shall be provided. It shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught. All tasks listed in the packet shall be listed on personalized student record sheets. The teacher's assessment guide shall include directions for authentic skill assessment.

Amatrol Model No. 90-EC1-A or equal

COMPUTER TECHNOLOGY 1 UNIT
Shall include: programmable controller, communications cable, power supply interface cable, student curriculum, interactive CDROM curriculum and instructor's guide. These components shall meet the following minimum specifications:

Programmable Controller
The controller shall be an industrial grade type, model Allen-Bradley Model Micrologix 1000, with specifications as follows:

- Programming Language: Ladder Diagram
- Memory Capacity: 1K
- Memory Type; EEPROM
- Contacts: Normally open and normally closed
- Coils (Internal Control Bits): Regular and Latched
- 1-Discrete Input Module: sourcing type, 10 inputs total, 24 vdc
- 1-Discrete Output Module: sourcing type, 6 outputs total, 24 vdc
- Mounting Type: Integrated Unit with processor and I/O
- Communications: RS-232
- Instruction set:
  -Relay control, basic math(eg add, multiply), comparison, BCD, program control (eg subroutine, master control relay), sequencer, Data Move, logic (eg and, or, not), timers, counters, immediate input/output, bit shift, multiplex
  stack(lifo and fifo), Interrupt, communications(eg message read/write), file manipulation

Training Console
The console shall consist of a rectangular, painted, silkscreened, steel-gauge unit with rubber foot mounts for table-top use and a mounting interface for use on a relay control trainer. The PLC and other components shall be mounted to this console and wired together to form a functioning circuit. The console shall contain an on/off switch wired to the main power of the controller, power cord, main fuse, 24 vdc power supply interface connection, individual banana jack connections for each I/O point to allow the controller outputs and inputs to be connected to outside devices.

Power Supply Requirements
This unit shall require use of an external 24 vdc power supply, which shall be separately supplied by some means.

Communications Cable
A cable shall be supplied to connect the PLC communications port with a serial port on a personal computer.

Student Curriculum
Shall consist of (2) sets of 3 Learning Activity Packets in print-based format and one set of interactive CDROM curriculum disks. The student curriculum shall include industry tasks in the following topics: operation, basic programming with programming software, coils, contacts, timers, counters, interfacing, systematic PLC program design and documentation, program design for motor control, event-driven pneumatic sequence programs. LAP material must match the online e-learning software and hands on trainer.

Amatrol Model No. 90-CT1 or equal

ELECTRIC MOTOR CONTROL SYSTEM
This system shall teach operation, installation, applications and troubleshooting of electric relay type motor control systems. The system shall contain the following items: Workstation Console, set of Control Stations, Hand-held Multimeter, Lead Set, Electric Motor, Motor Mounting Frame, Student Curriculum, and Instructor's guide. System shall perform fault insertion thru computerized fault insertion only, manual or toggle faults will not be accepted.

Workstation Console
Shall be a welded steel unit designed for mounting control panel stations. Measuring a minimum of 107cm x 51cm x 91cm. To include (3) vertical racks for control station positioning and (2) additional racks on the rear side for additional control station storage.

Control Stations
Each station shall be designed as a slide-in panel of at least 11 gauge thickness. Panels shall be painted and silk screened with labels and component symbols. Panels shall be pre-wired and terminated to banana jacks to allow quick connection of control circuits. Each station shall be designed with a plug-in ground jack that can be individually connected to a ground connection on the mounting unit. A complete set of green ground jumper leads will be supplied with sufficient quantity to permit plug-in connection of all stations. Station controls shall be compatible with 120 VAC power.

The following stations shall be supplied:

Safety Switch Power Station
(1)-Fused 3-phase safety switch
(2)-Padlocks
(2)-Safety tags
(4)-Banana jacks
(1)-Pre-attached power cord (4 pole, 5 wire)
(1)-Lockout/Tagout mechanism
(1)-Fault Module with (2) faults
(1)-Mounting unit for right angle orientation to trainer

Operator Station
(1)-Green flush push button (1 N.O., 1N.C.)
(1)-Black flush push button (1 N.0., 1N.C.)
(1)-Red mushroom push button (1 N.O., 1N.C.)
(1)-Three position selector switch (2 N.O.)
(1)-24in/61cm green stackable banana lead
(1)-5-way binding post (ground)
(1)-Fault Module with (5) faults

Indicator Lamp Station
(1)-Green indicator lamp
(1)-Push to test red indicator lamp
(1)-Yellow indicator lamp
(1)-24in/61cm green stackable banana lead
(7)-5-way binding posts (ground)
(1)-Fault Module with five (5) faults

Control Transformer Station
(1)-250VA control transformer with protective cover
(1)-Dual fuse block with protective cover
(4)-1.25 AMP class CC fuses (2 installed, 2 loose)
(1)-24in/61cm green stackable banana lead
(1)-5-way binding post (ground)
(1)-Fault Module with three (3) faults

Reversing Contactor Station

(2)- 4 pole contactors
(1)-Mechanical/electrical interlock
(1)-24in/61cm green stackable banana lead
(1)-5-way binding post (ground)
(1)-Fault Module with (5) faults

Overload Relay Station
(1)-A-B overload relay
(1)-24in/61cm green stackable banana lead
(1)-5-way binding post (ground)
(1)-Fault Module with (3) faults

Manual Motor Starter Station
(1)-Manual starter
(1)-24in/61cm green stackable banana lead
(1)-5-way binding post (ground)

Multifunction Timer Station
(1)-Multi-function timer with:
on delay, off delay timing
interval, single shot timing
repeat cycle timing, pulse timing
(1)-24in/61cm green stackable banana lead
(1)-5-way binding post (ground)
(1)-Fault Module with (4) faults

Drum Switch Station
(1)-Three phase reversing drum switch
(1)-24in/61cm green stackable banana lead
(1)-5-way binding post (ground)

Limit Switch Station
(2)-Industrial grade limit switch (SPDT)
(1)-24in/61cm green stackable banana lead
(1)-5-way binding post (ground)
(1)-Fault Module with (3) faults

Control Relay Station
(2)-Four pole relays (2 N.O. / 2 N.O.)
(1)-24in/61cm green stackable banana lead
(1)-5-way binding post (ground)
(1)-Fault Module with (5) faults

Pressure/Float Switch Station
(1)-Pressure switch (SPDT)
(1)-Float switch (N.O. or N.C.)
(1)-24 in/61cm green stackable banana lead
(1)-5-way binding post (ground)

Motor Connection Station
(1)-Multi-pin industrial motor connector
(5)-Red banana jacks
(5)-Yellow banana jacks
(1)-Fault Module with (3) faults

Hand-Held Digital Multi-Meter

Stackable Banana Lead Set - 50 Leads

3 Phase Induction Motor
A 1/3 HP, NEMA 56 Frame machine rated at 208-230/460 Volts, 3 phase. Windings accessible through a multi-pin connector. To include:
(1)-Motor Mounting plate
(1)-Single end shaft for safety
(1)-Motor winding identification escutcheon
(1)-Fault Module with (2) winding faults

Motor Mounting Frame
Shall be heavy duty steel frame construction, with pre-drilled holes for mounting of two motors, prony brake, electric brake, and flywheel. Minimum dimensions shall be 27" W x 12" D x 4" H. The mounting surface shall be made of .125-in steel plate min, painted and silk-screened.

Student Curriculum
The student curriculum shall consist of (1) set of 10 Learning Activity Packets 73 skills in electric motor control. The topics covered shall include: motor starters, reversing starters, overload relays, motor start/stop control, control transformers, magnetic motor starters, two wire control, three wire control, sequence control, jogging, on and off delay timing, sensor switches, and motor timer control. Students will learn installation, operation, schematic reading, circuit design, and troubleshooting.

The student curriculum shall be designed in a skill-based format that focuses on teaching industry-relevant tasks. The objectives shall be accomplished by organizing the learning material into a series of learning activity packets, which are further subdivided into three or more segments per packet. All learning material needed shall be contained in the packets including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. The specific cognitive skills taught by each text passage shall be identified next to the passage. Each lab activity shall be identified by the industrial task taught. All activities shall be highly detailed with step-by-step instructions to facilitate a self-directed learning environment. A combination of step-by-step enabling activities and creative, problem-solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. The curriculum must be capable of both self-directed and instructor directed study. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams. Learning activity packets must match the online e-learning material and the hands on trainer.

Teacher's Assessment/ Portfolio Guides
A teacher's guide shall be provided. It shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught. All tasks listed in the packet shall be listed on personalized student record sheets. The Instructor's Package shall include directions for authentic skill assessment.

Amatrol Model No. 85-MT5 or equal

PRONY BRAKE

A shaft torque measurement and load device. It shall consist of a formed steel gauge unit, aluminum brake drum with mounting for 5/8-inch motor shafts, balanced pulley, spring force gauge, load adjustment knob, double set screw locking device, coolant spray bottle. Load range shall be 0-3.05 N-m

Amatrol Model No. EL613-43 or equal

FAULT TROUBLESHOOTING SYSTEM FOR MOTOR CONTROL

This system shall consist of a computer-based fault controller, (2) ribbon cables, (1) computer managed software, (1) installation/operation manual. This system shall be designed and programmed so that students can connect the system to a wide variety of industrial controls training systems to provide a means by which faults can be automatically inserted into a training system to provide student practice in troubleshooting the system.

This system shall be compatible with the following types of training systems specified: electrohydraulics, electropneumatics, hydraulic servo, electronic sensors, programmable controllers, electric servo, electric motors, process control, robotics.

The characteristics of the system should be as follows:

Fault Controller
Shall include enclosure with 35 fault relays, 10A 115/230 VAC rating, 35 cables, ribbon cable for connection to a host computer, computer-based controller, internal power supply, 120/230 VAC 50/60 Hz. Faults must be inserted via a computer and not faulted manually or thru toggle switches.

Computer Managed Software
A Windows-based software program shall be supplied which is designed to provide an on-line interface for student troubleshooting and data-base record keeping of student responses. This software package shall give teachers the ability to create custom templates for each troubleshooting exercise so students are presented with an appropriated troubleshooting experience for each lab activity. Faults can be added or deleted to each exercise as needed.

The software shall feature on-line student control of the troubleshooting activity. This will allow students to set up and perform their own troubleshooting exercises for both practice and testing sessions. The program shall allow the student to initiate faults by entering a specific fault or initiating an automatic mode where the computer automatically selects a fault.

The student shall be able to enter the solution on the computer and the computer will indicate if the solution is correct, track the time spent, and number of incorrect/correct solutions.

Student responses are automatically recorded in the student database and scored according to a rubric which can be customized by the teacher. The data recorded includes: faults mastered, total time spent on each fault, and the number of tries needed to master each fault. Class statistics can also be generated so that teachers can analyze the curriculum and student skills.

Reports shall be able to be generated by student or class to show tasks accomplished and grade.

Amatrol Model No. 890-FTS-1 or equal

MOTOR BRAKING SYSTEM
Adds on to Electric Motor Control System. Allows students to learn various braking methods used by industry. To include the following: electromagnetic brake, plugging switch, inertial load device, DC brake station, and student curriculum. These components shall meet the following minimum specifications:

Electromagnetic Brake
Fail-safe design, foot mount, 24 VDC coil, spline connection to electric motor shaft, 20 in-lb torque.

Plugging Switch
Programmable, solid-state, over speed/under speed, SPDT output, tachometer function.

Inertial Load Device
(2) adjustable flange-mount bearings, 6" x ¼" steel flywheel, stainless steel shaft, and safety cover.

DC Brake Station
To supply 24 VDC for electromagnetic brake and DC injection. The components shall be mounted on a slide-in panel of at least 11- gauge thickness. The panel shall be painted and silk -screened with labels and component symbols. The panel shall be pre-wired and terminated to banana jacks to allow quick connection of control circuits. The station shall be designed with a plug-in ground jack, which can be individually connected to a ground connection on the mounting unit. A green ground jumper leads will be supplied to permit plug-in connections of the station. To include the following components:

- Step-Down Transformer
- Bridge Rectifier

Student Curriculum
The curriculum must be capable of both self-directed and instructor directed study. It shall be designed in a skill-based format that focuses on teaching industry-relevant tasks. The objectives shall be accomplished by organizing the learning material into a series of learning activity packets. Included shall be (1) Learning Activity Packet containing at least 8 skills in braking. The topics shall include the different braking methods of plugging, electromagnetic and DC injection. Skills shall include installation, circuit design, application, selection, and operation.

Amatrol Model No. 85-MT5-A or equal

PROCESS CONTROL LEARNING SYSTEM

This system shall include: a process control system, student curriculum, and a teacher's assessment guide. These items shall meet the below minimum specifications.

Process Control System

The process control system shall consist of industrial quality components mounted and assembled on a heavy duty bench-top workstation with the capability to teach a variety of process control applications. The components of the system shall include the below components.

(1)Workstation with:
- Dimensions 66-in (167cm) L x 46-in (117 cm) H x 28-in (71 cm) W
- Welded steel tube construction with all components mounted and plumbed on two heavy-duty gauge steel panels which are painted and silkscreened
- **Requires: 120 VAC power and compressed air.**

(1) Centrifugal Pump
(1) Electric Motor, single phase
(1) Proportional Control Valve, pneumatically-operated
(1) I/P Converter, 4-20ma input, 3-15 psia output
(1) Pneumatic Regulator and Pressure Gage
(1) Reservoir Tank, 10 gal, transparent with:
- Drain Valve, ball type

(1) Process Tank, 5 gal, transparent with:
- 1-2-Compartment Baffle
- 2-Drain Valve, ball type
- 2-2-Way Valves, Solenoid Operated, 24 VDC
- 1-Liquid Level Transducer, pressure-type, 4-20 ma output, 0-1psia range
- 2-Float Switches, SPST

(1) Piping Network with:
- 1-Pump flow control valve, ball type with V-notch
- 1-Pump Valve, 2-Way Valve, Solenoid Operated, 24 VDC
- 2-Control Mode Valves, ball type
- 1-Flow Meter, rotameter type, 0-2.0 gpm water
- 4-Pressure Gages, 0-30 psig, 2-1/2 inch
- 1-Flow Transducer, Paddlewheel type, 4-20ma output

(1) Control Panel with:
- Process Meter with:
  - -4-20ma input
  - -(2) alarm relay outputs, SPDT
  - -Scaleable Output Display
  - -Digital Display, 3-1/2 digit
  - -Programmable
- PLC I/O Interface with:
  - -Banana jack connection to process components
  - -DB cable connection to PLC
  - -(8) Discrete Inputs
  - -(8) Discrete Outputs
  - -(4) Analog Inputs
  - -(4) Analog Outputs
- Power Supply, 24VDC, 2.4 Amp
- Relay Control Unit with banana jack connections
  -) Control Relays, DPDT, 24 VDC
  - -(4) Selector Switch Inputs, 2-Position
  - -(4) Output Indicators, 24VDC
  - -(1) Pump Contactor Relay, 24 VDC
  - -(3) Solenoid Valve Output interface

- 1-Ground Fault Circuit Interrupter Switch
- 1-Duplex Power Outlet
- 1-On/ Off Switch with circuit breaker, 15 Amp
- 1-Power On Indicator
- 1-Lockout/ Tagout Set
- 1-Alarm Output, 24 VDC

Student Curriculum
The student curriculum shall consist of one (1) set of 10 Learning Activity Packets with at least 53 skills in process control systems. The topics shall include: introduction to process control, instrument tags, piping and instrumentation diagrams, loop controllers, final control elements, level measurement, liquid level control, methods of automatic control, basic flow measurement and control and control loop performance. The curriculum must be capable of both self-directed study and instructor directed study.

The student curriculum shall be designed in a skill-based format that focuses on teaching industry-relevant tasks. The objectives shall be accomplished by organizing the learning material into a series of learning activity packets, which are further subdivided into three or more segments per packet. All learning materials needed shall be contained in the packets including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. The specific cognitive skills taught by each text passage shall be identified next to the passage. Each lab activity shall be identified by the industrial task taught. All activities shall be highly detailed with step-by-step instructions to facilitate a self-directed learning environment. A combination of step-by-step enabling activities and creative, problem-solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. The curriculum must be capable of both self-directed and instructor directed study. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams. Laps and hands on trainer must match online e-learning system verbatium.

Teacher's Assessment/ Portfolio Guides
A teacher's assessment guide shall be provided. It shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught. All tasks listed in the packet shall be listed on personalized student record sheets. The teacher's assessment guide shall include directions for authentic skill assessment.

Amatrol Model No. T5552 or equal

PID CONTROLLER MODULE

Shall include a PID controller meeting the following specifications listed below.

- Honeywell UDC3500 series controller
- Microprocessor based
- Ethernet communications
- Infrared PC and pocket PC configuration
- LED display
- Digital programming
- Autotune
- Single-loop control
- 4-20 mA analog input
- 4-20 ma analog output
- (2) discrete inputs
- (2) Alarm relay outputs (SPDT) resistive load, 5amps@120/240VAC or 30VDC Inductive load 3amps@130/250VAC
- Banana jack interconnections
- Tuning keypad
- Mounting panel with silkscreened legends

The PID controller shall be fully compatible with the process control system's hardware and supported by the process control system's curriculum. It shall have the capability of controlling the system in both the open-loop and closed-loop modes of operation. All connections to the output and input devices shall be via plug jacks. The PID control module shall be able to mount directly into the control panel of the process control system.

Amatrol Model No. T5552-C1-A or equal

PNEUMATIC TROUBLESHOOTING SYSTEM

This system shall teach troubleshooting of pneumatic components and systems as well as the operation of advanced pneumatics components and systems. It shall include a mobile workstation, control center, air compressor, actuator panel, pneumatic troubleshooting and servicing package, student curriculum, and teacher's guide.

Mobile Workstation

This workstation shall be constructed of 1.5(3.81 cm) square steel, which will be welded and braced. It shall be designed to mount pneumatic circuit panels to a vertical portion of its frame and an optional air compressor to the base of its frame. The minimum dimensions shall be 72" (183 cm) L x 72" (183 cm) H x 28" (71 cm) W. Four swivel casters (two locking) shall be supplied. The workstation frame shall be primed and painted.

Pneumatic Circuit

The pneumatic circuit supplied shall consist of numerous heavy duty industrial pneumatic components which are pre-mounted on a steel mounting panel. The mounting panel shall be painted and silkscreened with Test Station labels and designed to mount to the vertical frame of the mobile workstation. The components shall be connected to each other through plastic tubing using industrial type fittings and connected in such a way to simulate an industrial pneumatic application. Each of the pneumatic circuit panels shall be connected to the air compressor supply thru the branch line drop leg.

Compressed Air Supply

Shall include the following:

(1)-System Inlet Quick Connect for interconnection with building compressed air system
(1)-Optional integrated air compressor

System Header

Shall include the following components:

(1)-Main Header Line with System Quick Connect – 20 mm Pneumatic Rated PVC Pipe
(1)-System Inlet Pressure Gauge-2 ½"
(1)-Branch Line Drop Leg – 3/8" Steel Tubing with Steel Compression Fittings
(1)-Filter with Manual Drain
(1)-Regulator with Gauge
(1)-Automatic Drain Trap
(1)-Collection Reservoir
(1)-Pneumatic Lockout/Tag-out with Vent
(1)-Electrical Pressure Switch
(7)-Test Stations

Overrunning Load Circuit

Shall include the following components:

(1)-Directional control valve, 5-way, 3-position, blocked center, internally pilot-operated, double solenoid, subplate mounted
(2)-Air over oil tanks
(2)-Hydraulic flow control valves
(1)-Hydraulic Cylinder, jic type, 12 in stroke, 1-1/2 inch bore, adjustable cylinder cushions
(2)-Electrical limit switches, DPDT, metal enclosure type, roller arm type
(1)-Load device, 75-lb weight, attached to the cylinder rod
(6)-Test Stations

Compression Load

Shall include the following components:

(1)-Directional control valve, 5-way, 3-position, blocked center, internally pilot-operated, double solenoid, subplate mounted
(1)-Cylinder, jic type, 6 in stroke, 1-1/2 inch bore, double acting

(2)-Inductive limit switches
(1)-Load device, heavy duty compression load spring
(1)-Regulator, relieving type with integrated bypass check valve, and pressure gage
(5)-Test Stations

Running Load Circuit
Shall include the following components:
(1)-Directional control valve, 5-way, 3-position, open center, internally pilot-operated, solenoid-controlled, subplate mounted
(1)-Lubricator
(2)-Flow control valves, independently mounted
(1)-Pneumatic Gear Motor, industrial type
(1)-Load device, caliper brake with independent DCV
(1)-Precision braking regulator with gage
(1)-Flywheel-4 lb inertial load
(1)-Flywheel Guard
(5)-Test Stations

Radial Load Circuit
Shall include the following components:
(1)-Directional control valve, 5-way, 2-position, detented, pilot-operated, solenoid-controlled
(2)-Flow control valves, exhaust restrictor type
(2)-Limit Switches, compact, roller arm type
(1)-Rotary Actuator, vane type, double acting, 180 degree rotation minimum
(1)-Hydraulic Shock Absorber, adjustable deceleration
(2)-Test Stations

Vacuum Load Pneumatic Circuit Panel
Shall include the following components and be assembled in such a way that a 1" diameter ball bearing can be picked up by the vacuum cup at least 4 inches and transported horizontally at least 12 inches. The part then shall be returned to its original location by a gravity feed system:
(4)-Directional control valve, 5-way, 2-position, detented, pilot-operated, solenoid-controlled
(1)-Directional control valve manifold, 4-station
(3)-Flow control valves-independently mounted
(2)-Flow control valves-cylinder port mounted
(1)-Pressure Regulator with gauge, non-relieving
(1)-Vacuum Generator
(1)-Vacuum Cup
(1)-Quick Exhaust
(1)-Rodless Cylinder, 1-inch bore, 12-inch stroke
(1)-Cylinder, 4 in stroke, 1/2- inch bore, double acting
(1)-Gravity Feed Part System
(2)-Queue Cylinders, ½-inch bore x 1-inch stroke, single acting
(1)-Limit Switches, compact, roller arm type
(2)-Proximity Switches, SPDT with metal enclosure, magnetic type, mounted to cylinder
(2)-Proximity Sensors, SPDT, Reed switch type mounted to rodless cylinder
(10)-Test Stations

Pneumatic Troubleshooting and Servicing Package
The instrumentation shall provide measurement of pressure and flow for troubleshooting at various points in the system, shall include:

(1)-Flow Meter
(1)-Manometer

(3)-Pressure Gauges, 0-160 psig, 2.5-inch, with quick connect fittings

Control Center
The control center shall provide control of the operation of the pneumatic system to provide a realistic machine operation experience. All components shall be mounted to an enclosure, which is in turn mounted to the system frame. The enclosure shall be metal gage, primed and painted. It shall contain the following components:

(1)-Programmable Controller, 32 inputs and 24 outputs
(1)-Electrical Lockout/Tagout
(1)-Circuit Breaker Switch
(4)- Indicator Lights - Power On, System Pressure, System Ready, and Cycle Active
(1)-Thumbwheel switch with 8 selectable program sequences in automatic mode
(1)-Thumbwheel switch with 8 manual actuator jog selections in manual mode
(1)-Cycle Start Pushbutton
(1)-Cycle Stop Pushbutton
(1)-Actuator Jog Selector Switch, forward/reverse
(1)-Idle/Manual/Auto selector switch
(1)-Brake Control Pushbutton
(1)-Emergency Stop Pushbutton, hard-wired

Fault Insertion System
Each circuit panel shall also include a number of faults, which recreate actual pneumatic component and system failures. The circuits shall also include realistic troubleshooting test points so that students can perform systems-level troubleshooting without disassembling components. A minimum of 24 electrical faults, 23 pneumatic/mechanical faults, and 11 adjustment faults shall be provided to assure that students will be presented with realistic range of troubleshooting experiences. The pneumatic/ mechanical faults shall be inserted electrically and create the simulation of stuck spools, failed regulators, failed flow control valves, worn cylinder and rotary actuator seals, stuck loads, blocked lines, and worn spools.

A minimum of 35 pneumatic test points shall be provided to enable students to test pressures at points before and after each device. All faults shall be transparent to the student. No equipment shall be mounted to the front of the panels that does not look like a part of the circuits. All electrical and pneumatic faults shall be created electrically by one or more solenoid operated pneumatic valves mounted on the rear side of the trainer. These valves shall be connected to the specified computer-based fault insertion system.

Computer Based Fault Troubleshooting System
This system shall consist of PC-compatible fault controller card, (2) 4' Ribbon Cables, (1) integrated fault insertion relay circuit board, (1) computer-managed software, and (1) installation/operation manual. This system shall be designed and programmed so that students automatically insert faults into the pneumatic training system to provide student practice in troubleshooting the system. The characteristics of the system should be as follows:

Fault Controller
Shall include PC digital I/O fault control card to be mounted within user provided computer. The digital I/O card shall insert in a standard Windows-based PC and connect to the fault relays via 2 ribbon cables. The fault insertion relay circuit board with 47 fault relays, .5A @ 115VAC each, shall be mounted inside the control center enclosure. Through the software the controller shall be able to insert faults into the fluid power and electrical controls. Fault insertion shall be done via computerized insertion. Manual faults or toggle switches will not be accepted.

Computer Managed Software
This software shall be a Windows 98-based or higher software program and it should provide an on-line interface for student troubleshooting and database record keeping of student responses. This software package should give teachers the ability to create custom templates for each troubleshooting exercise so

students are presented with an appropriate troubleshooting experience for each lab activity. Faults can be added or deleted to each exercise as needed.

The software should feature an administrative section and a student section, both of which are password protected. The administrative section should feature a teacher section, class section, student section, report section, template section, and grade setting section. Each section should include the ability to enter new data, edit existing data, and delete data.

The teacher section should be able to set up a database of teachers, who are authorized to create classes, templates, and edit student data. The student section should contain a database of students that is separate from the class databases. Students should be able to be enrolled in multiple classes using one set of student data. Student data should include: name and student ID.

The class section should allow classes to be entered into the system with each class containing the following data: class name, class number, class dates, class template, students enrolled, and number of students enrolled. Students should be able to be enrolled through a drag and drop from a student database window. A template should be able to be selected from a list of existing templates.

The template section should allow the user to create a template that can be used in more than one course to create faults and evaluate students during their troubleshooting exercises. The template should use a tree-type structure with the following levels: course title, module title, LAP or chapter title, troubleshooting skill title, and hardware station titles. Users should be able to open the tree structure to display any or all of these levels. At the skill level, the software should display the faults that could be inserted into the learning system and which ones are active for that skill. At the hardware station title, the screen should display the faults associated with that station that are used for the skill. The software should also have a section to allow faults associated with a particular trainer to be entered in a database, allowing new templates to be created using a particular trainer. This database should include the stations associated with the trainer, names of the faults, type of fault, and fault number. New class templates should be able to be created by adding a trainer template to the class template and setting the faults to active or inactive for each skill.

The grade setting section shall allow the user to determine what skill level is given for each student's troubleshooting exercise based on the time spent, number tries, and final mastery. A point scale of 0-4 should be available with each level determined by a minimum achievement based on these criteria. Each troubleshooting exercise should be individually adjustable.

Reports shall be able to be generated by student or class to show tasks accomplished and grades. The reports should be available in print and electronic formats. The report data should show the skills performed by each student for each class, including: number of faults mastered, total time spent on the faults for that skill, and the number of tries needed to master the faults, and skill level attained.

The student section should contain features to enable viewing of grades, random fault troubleshooting and manual fault troubleshooting. The manual fault troubleshooting should feature on-line student control of the troubleshooting activity through a menu-driven prompt screen. Students should be able to initiate faults by entering a specific fault. The screen should indicate when the fault has been inserted and allow the student to clear the fault by clicking on a clear fault button on the screen.

The random troubleshooting feature should permit students to enter an automatic mode where the software automatically selects a fault and the student must determine which fault has been inserted. This section should allow students to set up and perform their own troubleshooting exercises for both practice and testing sessions. The practice session should work in an identical manner to the test session except that grades are only reported for the test session. The student

should be able to enter the solution through a menu-driven prompt screen and the software should indicate if the solution is correct and track student data. Student responses are automatically recorded in the student database and scored according to the rubric in the grade setting section of the software. The faults selected by the software during the random troubleshooting session should be selected randomly by the software from the active faults contained in the template for each particular skill. An online help screen should appear at all times during the troubleshooting sessions, both random and manual, to assist the student in performing the correct procedure.

Student Curriculum
The curriculum shall consist of one (1) set of 5 Learning Activity Packets The student curriculum shall contain at least 40 industry skills covering applications of advanced pneumatic systems, installation, maintenance, and troubleshooting.

The student curriculum supplied shall be designed in a skill-based format that focuses on teaching industry-relevant tasks. The objectives shall be accomplished by organizing the learning material into a series of learning activity packets, which are further subdivided into three or more segments per packet. All learning material needed shall be contained in the packets, including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. The specific cognitive skills taught by each text passage shall be identified next to the passage. Each lab activity shall be identified by the industrial task taught. All activities shall be highly detailed with step-by-step instructions to facilitate a self-directed learning environment. A combination of step-by-step enabling activities and creative, problem-solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. The curriculum must be capable of both self-directed and instructor directed study. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

Teacher's Assessment/ Portfolio Guides
A teacher's guide shall be provided. It shall contain student data sheets, data sheet solutions, self review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught. All tasks listed in the packet shall be listed on personalized student record sheets. The Instructor's Package shall include directions for authentic skill assessment.

Amatrol Model No. 950-PT1 or equal

ROBOTICS AND COMPUTER PROGRAMMING UNIT 1
Shall include articulated servo robot, robot controller, teach pendant, programming cable, robot control software, flexible workstation, controller mounting module, keyboard and monitor mounting module, utilities distribution module, electrical power module, compressed air distribution module, basic parts set, gravity feeder, application workcell package, robotic simulation software, robotic conveyor module, student curriculum and teacher's assessment guide. The components shall meet the minimum specifications listed below.

Articulated Arm Servo Robot System
Shall include servo robot arm, computer controller, servo gripper, teach pendant, on-line/ off-line programming software and cable set. These components shall meet the minimum specifications listed below.

Manipulator Arm
The robot arm shall be of industrial quality and have articulated arm -type motion with a minimum of (5) electric drive axes plus gripper. All cables required for connection to robot computer controller shall be included. The computer controller shall be compatible with the robot arm and include at least five (5) axes of control including five (5) axes with closed loop speed, position and acceleration/deceleration programmable.
The minimum specifications listed below shall apply.

- Construction: articulated, double jointed, revolute
- Axes: 5
- Payload: 2.2 lb. (1 kg.)
- Repeatability: ±.007 in. (.18 mm)
- Maximum speed: 23.6 inches/second (599.4 mm/sec)
- Actuators: 6 DC servo motors with closed loop control
- Feedback: optical encoders on all axes
- Working envelope:
    - Waist: 345°
    - Shoulder: 220°
    - Elbow: 270°
    - Pitch: 270°
    - Roll: unlimited
    - Maximum reach: 24 inches (609.6 mm)
- Double jointed design with a plan envelope of 360°
- Gripper opening: 3 inches (76.2 mm)
- Transmission: gears, chains, and lead screw
- Homing reference: infrared, high precision sensors on all axes
- Gripper type: servo type with encoder
- Safety covers: metal covers on encoders, covers on all axes

Controller
The controller shall be a high performance design contained in a compact enclosure. Indicator lights shall be mounted on the front panel of the enclosure to show controller operating status and discrete I/O status. The controller shall have the minimum specifications listed below. A user supplied or separately purchased 1.6 GHz or faster Pentium PC with a USB 2.0 port running Windows XP is required to work with the controller.

- Control software that runs on a PC
- Accept commands on the fly from control software running on PC
- Provide feedback to the user via context sensitive screens on PC
- Virtually unlimited storage on PC
- Ethernet communications software via PC
- RS232 communications software via PC
- Additional interface functionality via PC

- Controller type: multiprocessor, real time, pulse width modulated
- Communication: USB 2.0 standard
- Internal visual system status indicators (10)
- Number of servo axes: 8 standard
- Axis control type: high performance PID motion processors that provide trajectory generation and related motion control functions. The system shall consist of high-speed Digital Signal Processor (DSP) computation units, along with ASIC (Application Specific Integrated Circuit). The PID filter loop shall be capable of operating at 100 microsecond loop cycle time per axis.
- State of the art surface mount technology multi-layer control circuit board
- Motor shall be driven by Power MOSFET UltraFet technology
- Power supplies shall be of a high efficiency switching type capable of running on an international power input 100-240VAC @50/60Hz and shall be short circuit protected.
- Discrete inputs/outputs: 16 inputs that are 300 VDC reverse peak protected and have front panel indicators, 16 outputs that are relay-type and have front panel indicators.
- Discrete I/O interface panel- to include LED for each input/output point and a terminal connection
- Front panel indicators for power, robot enable and drive fault
- User notification of cable disconnect
- User power supply: built-in; 24 VDC, 3 amp with external terminal connections
- Safety features: axis over current protection (without using fuses or circuit breakers)
- Programming language: high level automation/robotic programming language with a minimum of 140+ executable commands
- Coordinates system: Cartesian and joint frame
- Motion Types: linear, circular and point-to-point move commands

Teach Pendant
An industrial quality teach pendant shall be supplied which includes a 2 line display, 4 function keys which can assume a large variety of specific functions according to the menu on the display, emergency stop push-button, jog capability, ability to enter and edit teach points, ability to tune servo axes, and perform startup of robot. The teach pendant shall have the ability to jog axes in four modes: joint, compensated joint, tool frame and Cartesian.

Programming Cable
A USB cable shall be supplied to enable users to transfer programs from the controller to a personal computer.

Robot Control Software
Shall be Windows-based software, which permits users to develop programs either on-line or off-line for the servo robot. Shall include mouse driven functions, program storage, robot startup, virtual teach pendant, full screen program editor, point file storage/display in Cartesian coordinates, real time robot position display in Cartesian coordinates and robot homing. The system shall display Cartesian coordinate commands in metric and English units. Shall include the commands listed below.

- Linear, circular and point-to-point move commands
- X,Y,Z Cartesian, X,Y,Z relative to variable tool plane
- Ability to create variable regional coordinate systems
- Palletizing command set
- Device interrupt, safety interrupt
- Ethernet communications
- Serial communications
- Gripper measurement command
- Multitasking variable sharing between programs
- Math functions
- Data manipulation functions
- Discrete and analog I/O control
- User display screen interaction

Flexible Workstation Package
This station shall include: (1) flexible workstation, (2) controller mounting modules; (1) utilities distribution and mounting module, (1) electrical power module and (1) compressed air distribution module. The components of this package shall meet the below minimum specifications.

Flexible Workstation
This station shall be constructed of 1.5-in (3.81 cm) square steel to be welded and braced. The minimum dimensions shall be 60" (152.4 cm) L x 30" (76.2 cm) H x 32" (81.28) W. The top shall provide a slotted-hole matrix compatible with other system components. Four casters shall be supplied. Mounting holes shall be provided to mount computer shelves, keyboard shelves, monitor shelves, and programmable controller modules. The workstations shall be able to be fastened to one another, both end-to-end and side-to-side to create larger application work surfaces. The workstation surface shall use a minimum of 11-gauge steel which is plated with a protective coating. This surface shall be bolted to the workstation frame so that it can easily be removed. The workstation frame itself shall be primed and painted.

Controller Mounting Module
This module shall provide the capability to securely mount various types of controllers including PC compatible computers underneath the workstation. The construction shall use a minimum of 16-gauge pre-formed gauge sheet steel with pre-drilled holes for mounting to the workstation. Holes shall also be provided for coupling modules together in order to mount more controllers. All required bolts and washers shall be included. The minimum dimensions shall be 8.5" H x 19.75" W x 18" L. The module shall be primered and painted.

Keyboard and Monitor Mounting Module
This module shall provide mounting of computer keyboard and monitor that can be attached to the workstation through a raised arm that swivels. It shall be designed to quickly and easily hook into the perforated surface of the workstation or detach for storage in the computer-mounting module. The construction shall be pre-formed sheet steel. The module shall be primered and painted.

Utilities Distribution and Mounting Module
This module shall be designed to mount underneath any workstation to provide controlled channeling of cables and hoses and to provide mounting of the compressed air, electrical power distribution modules, and power supply. This unit shall be made of high quality 16-gauge sheet steel. It shall be constructed as a channel measuring 9" (22.86 cm) W x 2" (5.08 cm) H x 60" (152.40 cm) L. It shall be primered and painted.

Electrical Power Module
This unit shall provide plug-in power connections to devices on a workstation. It shall provide at least six plug-in connections, illuminated power switch, surge protector, circuit breaker, grounded power cord, and mounting panel maximum combined current of all devices shall be at least 15 amperes. The mounting module shall be painted and labeled. It shall be designed to mount to the utilities distribution module.

Compressed Air Distribution Module
This module shall provide connections for the compressed air supply lines from various control devices in the work cell including pallet positioners, feeders, vises, chucks, and pallet transfers. This unit shall be designed to mount to the utilities distribution module. This module shall consist of the below components.

- Relieving type pressure regulator
- Pressure gauge
- 8-station control air manifold with quick-connect fittings
- Power air quick-connect for powering a pneumatic robot
- 20' (6.1 m) of air hose for connection to an external supply

Basic Parts Set
Shall include the below components
(9) Aluminum blocks measuring 1.25 inches on each side to include:

(3) Anodized red, machined with a hole straight through block
(3) Anodized blue, solid no drilled holes
(3) Anodized gold, machined with the hole drilled to a depth of ¾ inch

Gravity Feeder
Shall be able to feed both cylindrical and rectangular parts for use in a robotic tending application. The system should be adjustable in part size, angle of feed, and part positioning. Adjustable guides: 1" to 4"; adjustable slope: 0-40 degrees; mounting legs, 12" feeder length; adjustable height legs, heavy gage steel construction.

Application Workcell Package
This work cell shall consist of components to be used with a bench-top robot to teach operation, programming and application of robotic systems. These components shall be compatible with the curriculum supplied with the specified robotic system. The work cell shall include the below components.

(1) Inspection station
(1) Operator station
(1) Palletizing module
(1) Cylindrical set
(1) Cylindrical parts rack
(1) Assembly station
(3) Parts bins
(1) Manual pushbutton
(1) Indicator light
(1) Feeder sensor

These components shall meet the below minimum specifications.

Inspection Station
To consist of the below components

(1) Mounting panel
(1) Rectangular parts fixture
(1) Electro-mechanical sensor with interface cable to robot
(2) Flexible mounting wings for electronic sensors

Operator Station
To consist of the below components

(1) Hand-held console with silk-screened panel
(2) Pushbuttons
(1) Selector switch
(1) Alarm sensor
(2) Indicator lights
(1) Robot interface cable with plug-in terminal strip

Palletizing Module
To consist of 9-station aluminum pallet, sized to mount 1.25-inch blocks

Cylindrical Set
To include three (3) .75 inch diameter X 3.0 inch long aluminum cylinders

Cylindrical Parts Rack
Aluminum mounting rack capable of mounting (3) cylindrical parts measuring .75- inch diameter cylinders in a vertical orientation

Assembly Station

This system shall perform work holding on 1.25 inch min. square parts and .75 inch min. round parts. To consist of the below components

- Aluminum mounting pad 3/8" X 4" X 6" drilled and tapped with a grid pattern of mounting holes
- Assembly V-clamp fixture
- Pneumatic cylinder
- 24 VDC solenoid-operated pneumatic valve
- Robot interface cable with terminal strip
- Mounting for sensors, fittings and hose

Parts Bins
To consist of (3) plastic bins measuring 6-in X 4-in, colored: red, blue, and yellow

Manual Push Button
To use industrial push button switch DPST, robot/PLC interface cable

Indicator Light
24 VDC red indicator with robot/PLC interface cable

Feeder Sensor
DPST limit switch bracket and cable to attach to the robot feeder to sense when the parts feeder is empty

Robot Simulation Software
A 1-station license of a PC-based software package that provides a 3-D simulation of articulated arm robot offline on computer will be provided. This software will be compatible with the programming code of the robots supplied with the system. Software shall be Windows-based and use a 3-D solid model. Capable of transferring simulation programs to run actual robot. The software is able to open and display 3 different views of simulated robot at the same time as well as coordinate information and program sequence. The software shall be able to perform simulated teaching, toggling of digital inputs and display of digital output status. A function shall be included which enables the user to create work cell objects using a library of standard parts shapes.

Robotic Conveyor Module
Shall include bi-directional linear conveyor of 32 inches in length and 4 inches wide. The drive system shall be a D.C. servomotor with optical encoder with resolution of 512 counts per complete revolution. The speed of the conveyor shall be 0-3.14 ins/sec (0-80 mm/sec) with a linear resolution of ±0.005 inches. The conveyor shall be capable of being operated in either the velocity or position mode.

Student Curriculum
The student curriculum supplied shall be designed in a skill-based format that focuses on teaching industry-relevant tasks. This curriculum shall be designed for use in a self-directed student-learning environment, which promotes a sense of rapid accomplishment and student motivation. The objectives shall be accomplished by organizing the learning material into a series of learning activity packets, which are further subdivided into three or more segments per packet. All learning materials needed shall be contained in the packets including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. The specific cognitive skills taught by each text passage shall be identified next to the passage. Each lab activity shall be identified by the industrial task taught. All activities shall be highly detailed with step-by-step instructions to facilitate a self-directed learning environment. A combination of step-by-step enabling activities and creative, problem-solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment.

The student curriculum shall consist of one (1) set of 8 Learning Activity Packets It shall contain at least 70 industry skills covering servo robot operation, teach pendant programming, on-line/off-line software programming, Cartesian coordinate programming, point array programming, simulation software, applications in machine loading, interfacing, quality control, conveyors, production operations, and operator interface. The curriculum must be capable of completely self-directed and instructor directed study. All subject content as well as hands-on activities shall be included in the student curriculum. All

activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams. Laps and hands on trainer must be compatible with the online e-learning software.

Teacher's Assessment Guide
The teacher's assessment package shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets, and assessment directions. The student data sheets shall be designed with data collection blanks to permit students to record data without consuming the learning activity packets. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught and correlated as such. All tasks listed in the packet shall be listed on personalized student record sheets. The teacher's assessment package shall include methods for both cognitive objective assessment and authentic skills assessment, with all skill assessment criteria explained in detail. Detailed instructions and any supplemental material shall be provided for the teacher to perform live assessment of each student.

Amatrol Model No. 94-RCP-1-A or equal

FLEXIBLE MANUFACTURING LEARNING SYSTEM

To include the following: serial communications module, laser barcode reader module, digital gauging module, linear traverse axis, FMS interface module, capacitive sensor, photoelectric sensor, cylindrical parts set, gearbox assembly parts set, lead set, robotic pen module, student curriculum, and teacher's assessment guide.

Serial Communications Module
Shall consist of an RS232 to USB communication adapter for connecting Digital Gauging Module to computers.

Laser Barcode Reader
The system shall consist of (1) laser barcode reader, (1) workstation mounting bracket, (1) The reader shall be fully compatible with the referenced robots, providing identification of part types for in process decision-making by the robot control program. The barcode reader system shall be industrial quality, capable of reading code 3 of 9 bar codes, and have a USB communications port. The bracket shall enable the height and angle of the barcode reader to be adjustable.

Digital Gauging Module
This module shall be designed to gauge length of rectangular and cylindrical parts using digital indicator. The gauge base shall be made of aluminum with a grid pattern of precision-drilled holes to permit flexible fixturing. The minimum dimensions shall be 6-in (15.2 cm) W x 12-in (30.4 cm) L x 0.25-in (0.6 cm) H. The module shall include flexible fixtures for precision measurement of the length of both cylindrical parts and rectangular parts. The digital indicator shall use an AC wall outlet (either 120VAC or 230 VAC, 1 phase) supply. It shall include a communications port, RS 232 serial communications adapter module, 0.01mm accuracy, keypad, LCD display, 2.54 cm probe travel, and probe retractor. An electro-pneumatic cylinder and valve shall control a clamping device to accurately position parts in the gauge. A second electro-pneumatic cylinder and valve shall extend and retract the indicator probe.

Linear Traverse Axis
Shall include lead screw driven mounting surface for robot arm, DC servo motor drive with encoder feedback, home position sensor, aluminum mounting base, 49.5-in (1257mm) length with 40-in (1016mm) travel, dual rail bearing slides, and robot control interface cable.

FMS Interface Module
This module shall provide for robot interface to discrete I/O devices such as sensors and CNC machines that do not have electrical interfaces that are compatible with the robot. The module shall include a sheet metal enclosure with silk-screened labels to accommodate plug-in interface of (2) independent electromechanical relays, (2) independent solid-state relays, 4-digit BCD thumbwheel switch, and TTL input switch. A 5-volt DC power supply with AC plug-in transformer shall be included.

Capacitive Sensor
Cylindrical body, slide-on mount, 24 VDC output.

Photoelectric Sensor
Polarized light reflector type, cylindrical body, slide-on mount, 24 VDC output.

Cylindrical Parts Set
Stainless steel material, Qty of (6) with dimensions of 1.2 cm diameter and length ranging 9.0 cm to 9.5 cm. The parts shall vary in dimensions to provide statistical variation to support robot program discrimination.

Gearbox Assembly Parts Set
This set shall include (12) spur gears, (6) aluminum casting gearbox housings, (6) transparent gearbox covers, (24) ratchet type fasteners, and gearbox storage pallet. The gearbox storage pallet shall be of

aluminum construction and shall be designed to vertically store at least (3) gearbox covers on one section of the pallet and (3) gearbox housings on another section of the pallet. The pallet shall be designed so the robot can automatically retrieve housings and covers individually.

Lead Set
This set shall include (20) leads with stacking plug-in jacks on both ends, 91.4 cm in length; (6) leads with stacking plug-in jack on one end and lead wires on the other, 91.4 cm in length.

Robotic Pen Module
This module shall enable a robot gripper to grasp a spring-loaded pen to permit robotic writing. This pen shall be used to demonstrate a variety of robot capabilities including straight-line motion, region commands and pallet commands.

Student Curriculum
The student curriculum supplied shall be designed in a skill-based format that focuses on teaching industry-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment which promotes a sense of rapid accomplishment and student motivation. The objectives shall be accomplished by organizing the learning material into a series of learning activity packets, which are further subdivided into three or more segments per packet. All learning materials needed shall be contained in the packets including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. The specific cognitive skills taught by each text passage shall be identified next to the passage. Each lab activity shall be identified by the industrial task taught. All activities shall be highly detailed with step-by-step instructions to facilitate a self-directed learning environment. A combination of step-by-step enabling activities and creative, problem solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment.

The curriculum shall consist of one set of Learning Activity Packets. The student curriculum shall contain 51 industry skills covering advanced robot programming and workcell applications. The following topics shall be covered: region commands, external servo axes, palletizing commands, sensor interfacing, solid state relays, CNC to robot interfacing, World and Tool Coordinates, serial communications, digital indicators, automatic gauging, multitasking, program interrupts, barcode readers, ASCII data manipulation, robotic assembly, and straight line motion commands. The curriculum must be capable of completely self-directed and instructor directed study. All subject content as well as hands-on activities shall be included in the student curriculum. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams. Lap material and hands on trainer shall match online e-learning software exactly.

Teacher's Assessment Guide
The teacher's package shall contain student data sheets, data sheet solutions, self review answers, quizzes, quiz answers, student skill record sheets, and assessment directions. The student data sheets shall be designed with data collection blanks to permit students to record data without consuming the learning activity packets. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught and correlated as such. All tasks listed in the packet shall be listed on personalized student record sheets. The Instructor's Package shall include methods for both cognitive objective assessment and authentic skills assessment, with all skill assessment criteria explained in detail. Detailed instructions and any supplemental material shall be provided for the teacher to perform live assessment of each student.

Amatrol Model No. 94-FMS-1-A or equal